Air Quality Assessments and Monitoring Programs for the Central Artery / Tunnel Project Boston, Massachusetts

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180,000 Vehicles

Central Artery / Tunnel Highlights

- 2 Two-lane tunnels under Boston Harbor (I-90)
- 2 Five-lane tunnels through downtown Boston (I-93)
- Ten lane cable-stayed bridge over Charles River
- 6 Ventilation Buildings
- 8 Longitundinally ventilated exit ramps


Charlestown
Central Artery North Area (CANA)
East Boston
North End
Central Artery
Boston Harbor
Logan Airport
Downtown
Third Harbor Tunnel
I-90/I-93 Interchange
Seaport Access Road
South Boston
By-Pass Road
Above/Below Ground
Above
Below


Gillette

Construction Highlights

Within 7.5 mile corridor

- 160 Lane-miles of new highways
- 80 Lane-miles of new tunnels
- 150 Acres of new parks
- 13 millon cu-yards of excavated material
- 4 millon cu-yards of concrete poured
- Over 200 pieces of construction equipment in simultaneous operation

Construction Period 1992-2005

- 1992 Utility Relocation
- 1992 Ted Williams Tunnel (TWT) started
- 1995 TWT opened to comercial traffic
- 1997 Downtown tunnels started
- 1998 Charles River Bridge started

Opening Schedule

- September 2002 — TWT / I-90
- November 2002 — I-93 Northbound
- November 2003 — I-93 Southbound (north section)
- November 2004 — I-93 Southbound (south section)

History of Environmental Assessments

- 1985 EIS/R
- 1990 Supplemental EIS/R (14 Volumes)
- 1991 ROD – FHWA/MHD
- 1994 Charles River Crossing SEIS/R
- 1995 FHWA Longitudinal Ventilation
- 1995-2000 Over 10 NPCs/ERs

Critical Environmental Aspects

- Disposal of excavated material
- Marine and aquatic impacts
- Pest control program
- Water quality on discharged waters
- Noise and vibration control
- Air Pollution control

Air Quality Analysis

- Regional (area-wide) emissions assessment
  - *Carbon Monoxide (CO), Nitrogen Oxides (NOx), Non-methane Hydrocarbons (NMHC), Particulatte Matter (PM_{10})*
- Localized (microscale) impacts at intersections
  - *CO*
- Impacts of ventilation system emissions
  - *CO, NO_2, PM_{10}*
- Impacts of construction activities
  - *CO, PM_{10}*

National & State Ambient Air Quality Standards (NAAQS)

- **CO**
  - *One-hour = 35 ppm*
  - *Eight-hour = 9 ppm*
- **NO_2**
  - *Annual 100 ug/m^3*
  - *One-hour 320 ug/m^3 (DEP Policy Guideline)*
- **PM_{10}**
  - *Annual 50 ug/m^3*
  - *24-hour 150 ug/m^3*

Air Quality Analysis
1990 SEIS/R Construction Period

- Localized CO modeling at intersections
  - *Year 1994*
  - *19 intersections*
  - *Highest 8-hour level = 11.1 ppm*
  - *3 Intersections above NAAQS*
- PM_{10} modeling at construction areas
  - *Excavation, earth moving, truck traffic,*
  - *3.7 acre, 5,300 tons/day, 250 trucks/day*
  - *Highest 24-hour PM_{10} = 160 ug/m^3*

Construction Air Quality Committee (CAQC)

- Formed 1991 as part of FHWA ROD
- Represented by:
  - *FHWA, MTA, EPA, DEP, City of Boston*
- Evaluates air quality impact studies
- Determines monitoring activities
- Recommends mitigation and control programs

CO Monitoring Program

Started 1992 ongoing

- Sites include most congested intersections
- Areas most affected by construction detours
- 4 – 8 sites - 3 weeks every winter
- Location: light poles – 10 feet height
- Two 8-hour periods per day
- Portable MiniVOL CO air samplers
- Air samples measured with NDIR analyzer


ONLY
DO NOT
ENTER


Street
Cleaning
2:01am-7:00am
Tow Zone

CO Monitoring Program Results 1992-2002

- 32 locations during 11 years
- 3,600 eight-hour samples collected
- Peak hour traffic 2,000 to 6,000 vehicles
- PM period higher than AM 90% of time
- Three highest locations 1993-1995
  - 5.6 to 7.1 ppm
- Same locations 2000-2002
  - 2.5 to 3.5 ppm

Dust Control Program

- Contract specific requirements
- Truck wheel wash stations
- Extensive use of watering trucks
- Dust suppresion agents (Soil-Sement)
- Dust screens and barriers
- Vacuum sweepers on paved roads
- Hydro seeding of stockpiles
- Crushed stones at ingress/egress roads


MACK


BARLETTA
11.060


54993


F73-178


600


WATER
Congress Street
Seaport


20


LIQUID FUN

Dust Control Inspection Program

- Inspect three times/week all sites
- Observable dust and diesel emissions
- Dirt tracking onto public roads
- Compliance with Dust Control Specification
- Enforcement (Deficiency Reports)

PM_{10} Monitoring Program 1992 - Ongoing

- One permanent station
- 8-10 portable MiniVOL samplers
- 3 weeks/year (1992-1996)
- 4 months/year (1997 -2001)
  - Twice a week – June to October
- Over 400 24-hours samples/year

PM_{10} Monitoring Program
Site Selection Criteria

- Level of construction activity
- Sensitive abutters
- Downwind from construction areas
- High levels measured in previous years
- Community concerns

PM_{10} Monitoring Equipment

- AIRMetrics MiniVOL Samplers
- CAHN C-33 Microbalance
- TEOM 1400 monitor
- RS-232 Data Logger


8 3 '95


SALEM ST
NO TURN ON RED
BUSES EXCLUDED
BUSES EXCLUDED
DETOUR AHEAD
ENDICOTT STREET
Fleet
FREE


ENSR

PM_{10} Results

- Permanent rooftop monitoring station
  - *25 – 70 ug/m³*
- Sidewalk monitors
  - *30 – 330 ug/m³*
- Mean construction impacts
  - *< 100 feet from construction area 10 – 80 ug/m³*
  - *100-250 feet from construction 10 – 40 ug/m³*

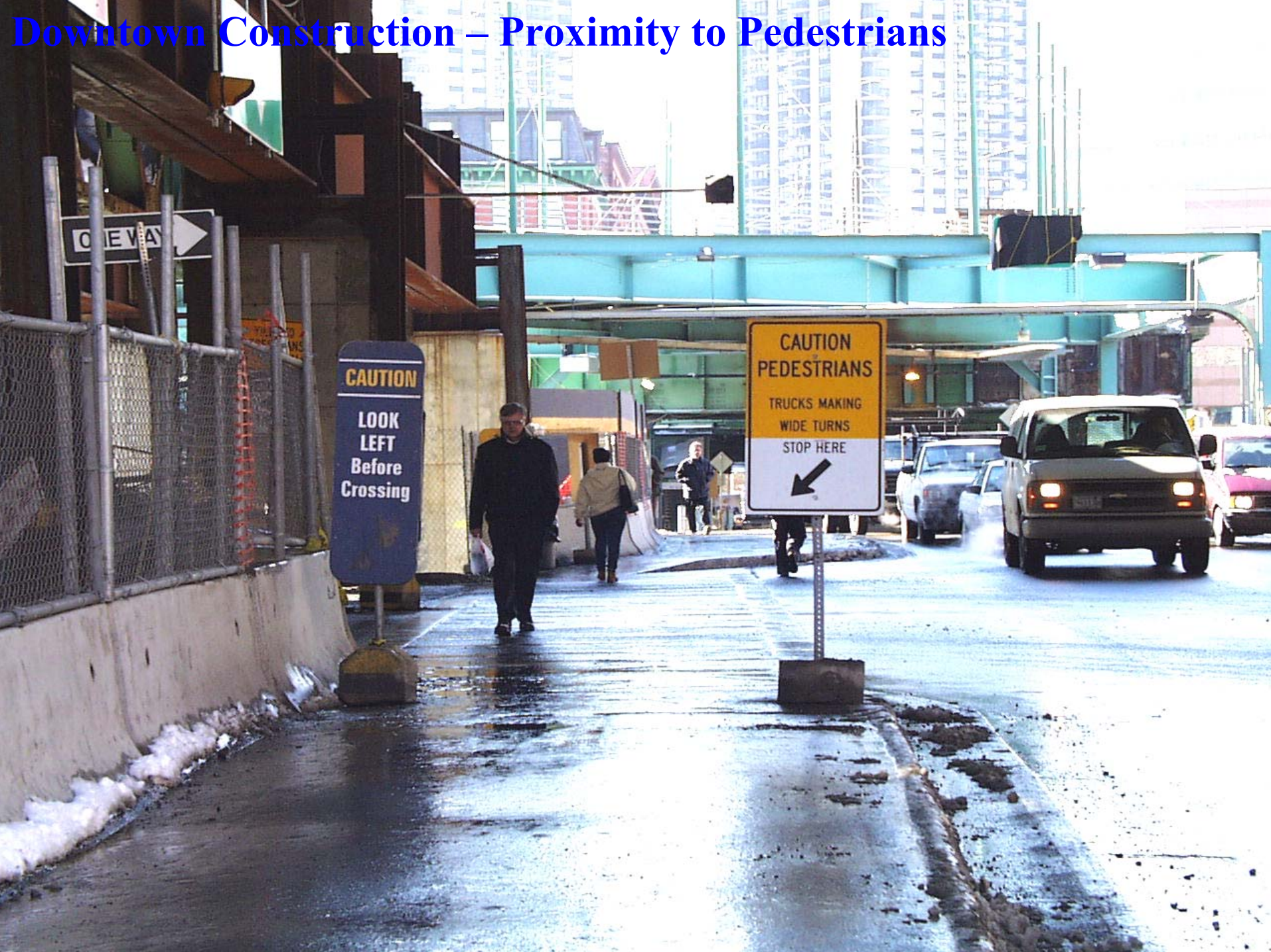
Construction Effects on PM_{10} Levels

- Effects of construction activities localized
  - *(less 250 feet)*
- Largest source of PM_{10} re-suspended dust from exiting trucks
- Additional mitigation and enforcement reduces peak increments by 50 %
- Background PM_{10} monitored levels constant during last 10 years (~ 30 ug/m^3 annual average)
- Highest PM_{10} levels cut by half from 1997 to 2001
  - *(330 ug/m^3 to 168 ug/m^3)*

Diesel Emission Control Program

- Assigned staging zones for waiting trucks
- Limit diesel idling to less than 5 minutes while not operating
- Retrofit construction equipment with oxidation catalysts

Downtown Construction – Proximity to Pedestrians




Parking
Only
ATTENTION
TRUCK DRIVERS:
STATE
REGULATION
ENGINE IDLING
TIME LIMITED
TO:
5 MINUTES
MAXIMUM
CHEVROLET
173·LYK

Downtown Tunnel Construction

Diesel Retrofit Program for Construction Equipment

- Reduce diesel impacts on abutters and construction workers.
- Help CA/T Project meet its environmental commitments.
- Reduce regional emissions.
- Good public relations.

Diesel Retrofit Program

- Originated in fall 1998 in collaboration with the Massachusetts DEP and NESCAUM.
- Only off-road equipment retrofitted.
- Focus on equipment near:
  - *Residential communities.*
  - *Hospitals.*
  - *Building fresh air intakes.*
  - *Underground areas (worker health & safety)*

Oxidation Catalysts Instead of Diesel Particulate Filters

- Reduce CO, HC, PM
- Ease of installation and maintenance
- Lower unit cost ($ 2,000 versus $ 13,000)
- Proven technology (over 1 million in use)

Retrofit Program Phase 1

- 8 pieces of equipment retrofitted
- 3 contractors participated
- Oxidation catalysts provided by MECA
- Contractors contributed installation costs
- Equipment manufacturers provided written assurance on engine warranty

Retrofit Program Phase 2

- Retrofitted 60 additional pieces of equipment
- CA/T paid ½ the cost of each oxidation catalyst
- Contractors paid remaining cost and installation costs

Equipment Retrofitted

- 50 – 300 HP range engines
  - cranes
  - lifts
  - excavators
  - bulldozers
  - generators
  - compressors


CATERPILLAR
D6R
C27


D6R LGP
McDERM

Retrofit Program Costs & Operational Issues

- Oxidation Catalysts cost $1,000 to $3,000 per unit ($2,500 average)
- Installation time < 2 hours.
- No adverse effects on equipment performance.
- 60 installed during Phase 2
- Warranty concerns (resolved in Phase 1)

Future CA/T Retrofits

- Retrofitting incorporated into Odor Control Specification 721.562
- 75 to 100 additional pieces of off-road pieces to be retrofitted between 2001 - 2004


CAT
REGD
TH83
THIS MACHINE
IS EQUIPPED WITH
AN AIR POLLUTION
CONTROL DEVICE
NOTIC

Emission Reduction Potential

Estimated % reduction according to EPA certification list

- CO = 40%
- HC = 50%
- PM = 20%

Emission Reductions of Retrofit Program

- For the year 2000:
  - *90 Kg/day (36 tons/yr) of CO*
  - *30 Kg/day (12 tons/yr) of HC*
  - *8 Kg/day (3 tons/yr) of PM_{10}*
- Based on 88 pieces of equipment retrofitted
- Reductions double between 2001 -2004
- Slowly decrease to 2000 levels after 2004


CATERPILLAR
CATERPILLAR

Discussion of Results
Construction Effects

Diesel Emission Control Program

- Very cost/effective way to reduce emissions
- Cost of oxidation catalysts 1-2 % of construction equipment
- Benefits 20-50 % emission reductions
- Elimination of diesel odors

Air Quality Trend
10 Years of Monitoring Data

- CO Downward ~ 50 %
- NO_2 Stable and down ~ 20 %
- PM_{10} Stable and down ~ 15 %
- O_3 Less NAAQS exceedances per year

Clean Fuel

- Use PuriNOx in diesel powered construction equipment
- PuriNOx - emulsified diesel fuel
  - *No. 2 Diesel + Additive + Water*
- Reduces NOx and black smoke
- Slight engine tuning required

PuriNOx Test

- Caterpillar 311B excavator
  - Model year 2000 – 79 HP Engine
- Three weeks – 16 hours/day
- 600 gallons of PuriNOx
- Tests compared No. 2 Diesel with winter blend of PuriNOx

PuriNOx Test Results

- NOx reductions 24% - 30%
- Black Smoke reductions 93% - 97%
- No performance problems
- Required slightly more power in deep mud conditions
- Fuel consumption slightly increased

COSTS
Oxidation Catalysts Vs Clean Fuel

- Oxidation Catalysts @ $ 8/HP
- PuriNOx @ $ 0.15/Gallon above No.2 Diesel

CA/T Environmental Oversight Committee

- Meets by-weekly to address community concerns/problems
- Consists of Project and City staff
- Provides window and dust treatment mitigation measures


KERALA STATE ELECTRICITY BOARD